

PHYS 600 Advanced Topics in Physics
Spring 2015 – “Frontiers of Experimental Particle Physics”

Information contained in the course syllabus, other than the absence policy, may be subject to change with reasonable advance notice, as deemed appropriate by the instructor.

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Office Hours: Monday/Friday 1 - 2 pm or by appointment

Meeting Time:

T Th 1:00 – 2:15 Herman Brown 223

Prerequisites:

The course builds on more formal material from PHYS 411/542 (Introduction to Nuclear & Particle Physics, text: Particle Physics, Martin & Shaw) and PHYS 543 (Physics of Quarks and Leptons, text: Halzen & Martin). Familiarity with the material at the level of PHYS 411/542 is sufficient.

Familiarity with Relativistic Quantum Mechanics at the level of PHYS 312 or 522 and/or concepts of Quantum Field Theory (PHYS 622) may be helpful, but is not necessary.

Textbook:

The Experimental Foundations of Particle Physics, **Second Edition**

Robert Cahn and Gerson Goldhaber

Cambridge University Press ISBN 978-0-521-52147-5

Additional required and optional readings will be made available in owlspace.

Course Description:

In this course we will cover recent and current research directions in particle physics, with a view towards the state of research at current facilities, including Fermilab, the Large Hadron Collider at CERN, and the Relativistic Heavy Ion Collider at Brookhaven National Laboratory. Students will gain a broad view of current research in particle and heavy ion physics, appropriate to entrance into graduate-level research in the field. Topics to be covered include: experimental foundations of the standard model of particle physics; electroweak symmetry breaking and searches for the Higgs Boson; searches for physics beyond the standard model at the energy frontier; indirect searches for new physics with high sensitivity experiments on CP violation, lepton flavor violation, and neutrino physics; and topics in relativistic heavy-ion collisions at RHIC and LHC. Additional topics may be added as time permits.

The course will follow a seminar format, where published journal articles in particle and heavy ion physics are assigned reading for class discussion in the context of current

research in particle physics. The instructor will usually give a brief introduction to key concepts before the discussion. Approximately half way through the course, students will be assigned to give the introduction and lead discussion on one or more topics in the remainder of the course. For most topics, assigned reading in Cahn and Goldhaber or from the course website on owlspace will provide essential background to the research articles. In some cases a review of material from prerequisite courses will be suggested. The discussion will range over the key concepts in the research papers, the impact and importance of the results, and the experimental and analytical techniques employed.

Course Objectives:

By the end of the course, students will be equipped to independently read, evaluate, and assess the research literature of particle and heavy ion physics, finding their way to answers to questions arising in experimental particle and nuclear/heavy ion physics graduate-level research. Students will also command a broad knowledge of current research directions in particle and heavy ion research and be familiar with many of the analytical approaches used in modern particle or heavy-ion experimental research.

Research paper and presentation:

In consultation with the instructor, students will choose a topic of interest (not covered in the class) and prepare a short presentation to introduce the topic and lead class discussion during the final meetings of the class. Following the format of the course, this includes selection of a journal article for participants to read, an introduction presentation presented by the student, and a class discussion led by the student on the chosen topic. Students will also prepare a research paper on the chosen topic submitted by the last meeting of the course.

The research paper and presentation assignments should represent your own work in accordance with the Rice Honor Code. In particular, any and all material used in preparing the research paper should be cited according to scholarly conventions, and the submitted content of the paper should be your own words.

Course Grade:

40% class participation & leading discussion of assigned topic(s)
30% written report on an area of research of interest to the student
30% oral presentation on report topic & leading class discussion

Absence Policy:

Course attendance is an important part of the instructional plan involving discussion and learning opportunities from peers and the instructor. Class participation is reflected in the assigned grade. Absences for illness or other reasons should be communicated to the instructor for consideration.

Disability Support:

Students with disabilities that require accommodation are encouraged to contact both the course instructor and Disability Support Services in the Allen Center so those accommodations can be made in a timely manner.

Schedule: (Subject to revision, changes will be announced & posted on the course web site)

Week of	Topic	Readings
Jan 12	Current Facilities: Accelerators, Detectors & Experiments	
Jan 19	Charm quark & tau lepton discoveries	CG ch 9
Jan 26	No class meetings (CERN)	
Feb 2	Jets at colliders & QCD	CG ch 10
Feb 9	Electroweak: W & Z bosons, precision EW	CG ch 12,13
Feb 16	Top Quark Discovery	CG ch 14
Feb 23	Searching for the Higgs Boson	owlspace
Mar 2	Spring Break (Mar 2-6)	
Mar 9	Higgs Boson Properties	owlspace
Mar 16	SUSY & Beyond the Standard Model	owlspace
Mar 23	Heavy Ion Collisions [guest discussion leaders]	owlspace
Mar 30	Heavy Ion Collisions; Spring Recess (Apr 2-3)	owlspace
Apr 6	Neutrino mixing & Dark Matter Searches	CG ch 16
Apr 13	Dark Matter (Apr 14) Report Presentations (Apr 16)	owlspace
Apr 20	Report Presentations (Apr 21,23)	